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Specification

Title of Invention

Fuel Supply Control Variable Cylinder System

Claim(s)

1. A fuel supply control type variable cylinder system for multi-cylinder engines equipped with a fuel supply system and a variable cylinder control circuit that permit partial cylinder operation by shutting off the supply of fuel to a specified group of cylinders from the fuel supply system depending on engine load, comprising a three-way catalyst and a first oxygen sensor located in the exhaust passage of the active cylinder group; a three-way catalyst and a second oxygen sensor located in the merged passage where the exhaust passage of the inactive cylinder group meets the downstream of the exhaust passage mentioned above; a selection circuit that selects the output of the first oxygen sensor under partial cylinder operation or the output of the second oxygen sensor under full cylinder operation depending on shut-off of the variable cylinder system circuit mentioned above; a temperature detection means that detects the temperature of the three-way catalyst in the merged passage; and an air-fuel ratio control circuit in which the fuel supply signal mentioned above terminates the shut-off operation when the temperature detection means detects that the temperature is below a specified value, while interrupting the air-fuel ratio control that controls the fuel supply signal in such a manner so as to make the air-fuel ratio become equal to the stoichiometric value.

2. The fuel supply control type variable cylinder system described in claim 1, a unique feature of which is that the temperature detection means mentioned above represents a circuit that determines the temperature by detecting that one portion of said fuel supply signal is shut off and that the output of the second oxygen sensor is higher than a specified value.

Detailed Explanation of the Invention

This invention concerns a fuel supply control type variable cylinder system engine equipped with a three-way catalyst in the exhaust system to feedback-control the air-fuel ratio; in particular, a system in which degradation of the exhaust emission control operation is prevented by resuming the full cylinder operation whenever the catalyst temperature decreases.

Generally speaking, engine fuel economy tends to improve when the engine is operated under a heavy load condition. This is the reason the variable cylinder engine concept was developed for multi-cylinder engines to stop the fuel supply to one group of the cylinders under a light engine load so that the relative load per each of the remaining cylinders can be increased leading to improved fuel economy under light load conditions.

On the other hand, from the standpoint of exhaust emission control measures, there is a well known system in which a three-way catalyst is installed in the engine exhaust system, upstream of which an exhaust sensor (oxygen sensor) is installed. In this system, the air-fuel ratio is feedback-controlled to become approximately equal to the stoichiometric value based on the output of this exhaust sensor in order to achieve high efficiency oxidation of HC and CO concurrently with reduction of NOx.

When this air-fuel ratio control system is employed with a variable cylinder engine, when a cylinder

group is inactive, the air exhausted from these inactive cylinders is mixed with the combustion exhaust gas from the active cylinders before it passes through the oxygen sensor and the three-way catalyst. This results in oxygen sensor output that indicates an oxygen rich condition so the feedback control forces the system to make the air-fuel ratio extremely lean, which in turn tends to degrade fuel economy.

One measure to address this problem is to install oxygen sensors and three-way catalysts in the exhaust passage of the cylinders that are always active as well as in the merged exhaust passage in which the exhaust passages from the active cylinders and inactive cylinders are joined. When one portion of the cylinders is inactive, feedback control is performed based only on the output of the oxygen sensor through which the exhaust gas from the active cylinders passes making the air-fuel ratio of the combustion exhaust gas approximately equal to the stoichiometric value. In this manner, the system can achieve good fuel economy and emission control at the same time.

There is, however, a problem during the engine warm-up period or during the time when the partial cylinder operation lasts a long time. The exhaust gas temperature tends to become low under these conditions, especially the temperature of the downstream three-way catalyst. It undergoes a large-scale decrease from its normal activated condition resulting from the entry of exhausted air from the inactive cylinders.

When the engine resumes full cylinder operation after the decrease in catalyst temperature, it is difficult to achieve good reaction at the downstream three-way catalyst which results in partial degradation of its exhaust emission control performance. This phenomenon tends to occur when a vehicle starts climbing uphill after it has been driven on a gently sloping downhill under the partial cylinder mode for a long time.

In order to eliminate this type of problem, there have been measures such as installing temperature sensors in the three-way catalysts in the exhaust passages. Whenever these temperature sensors detect a decrease in catalyst temperature below a specified value, the variable cylinder control system mode is interrupted to restore the full cylinder mode and expedite a quick increase in catalyst temperature. This measure, however, requires special temperature sensors and, inevitably, leads to cost escalation.

There is another measure in which a low engine temperature condition is detected by the engine coolant temperature and interrupting the variable cylinder control system. However, this system is still unable to solve the problem when the full cylinder operation is resumed, and tends to lower engine response characteristics.

Moreover, in the air-fuel ratio feedback control system mentioned above, similar to the three-way catalyst, the output characteristics of the oxygen sensors also tend to fluctuate and deviate from the proportionality with respect to the oxygen concentration when its temperature is decreased, resulting in impairment of the feedback control accuracy.

In order to address this problem, a normal procedure is to "clamp" the feedback signal to maintain the air-fuel ratio at a fixed value so that feedback control of the air-fuel ratio can be temporarily interrupted when the temperature estimated from the output of the oxygen sensor is determined to be below a specified value.

Based on such background, this invention is designed to assure the exhaust emission control performance

of a variable cylinder engine to control the air-fuel ratio based on the output of the oxygen sensor, which is located near the exhaust inlet of the three-way catalyst for the partially active cylinders, and which has similar temperature characteristics as those of the three-way catalyst temperature. When the downstream oxygen sensor temperature decreases below a specified value, feedback control of the air-fuel ratio is interrupted while at the same time the variable cylinder control system operation is also interrupted to restore full cylinder operation. With this method, the three-way catalyst temperature can be quickly increased by the combustion exhaust from all cylinders to prevent a decrease in the three-way catalyst temperature so that the good exhaust emission control operation can be maintained. The purpose of this invention is to introduce a fuel supply type variable cylinder engine that will achieve the performance explained above.

Next, a working example of this invention is presented using illustrations.

Number 1 represents the engine body, while f1 – f3 are inactive cylinders, the operation of which is stopped during the light load condition as explained later, and f4 – f6 are cylinders that are always active. Numbers 2a ~ 2f represent fuel injection valves installed in the intake ports of these cylinders, while 3 is an intake pipe, 4 a throttle valve, 5 an intake air flow sensor, and 6a and 6b are exhaust pipes for cylinder groups f1 – f3 and f4 ~ f6, respectively. 7 is a three-way catalyst installed in exhaust pipe 6b, and 8 is an oxygen sensor installed near the inlet of this three-way catalyst. 9 is a three-way catalyst installed in a merged pipe, 6, between exhaust pipes 6a and 6b, while 10 is an oxygen sensor installed near the inlet of three-way catalyst 9.

As described later, the air-fuel ratio control circuit, 12, receives the output of oxygen sensors 8 and 10 as input through a selection relay, 11, that performs the switching action based on the signal from a variable cylinder control circuit, 16, which is explained later. As depicted in Fig. 2, air-fuel ratio control circuit 12 is comprised of a comparator, 13, which compares the sensor output with the comparison standard voltage; a standard voltage setting device, 14, that outputs standard voltage corresponding to the stoichiometric air-fuel ratio; a correction waveform generation circuit, 16, that receives base pulses from a terminal, 15; a low catalyst temperature detector, 17, that detects the low temperature condition of oxygen sensor 10; and a clamp circuit, 20, which clamps (sets the air fuel ratio feedback valve at a specified valve irrespective of the outputs of oxygen sensors 8 or 10) the feedback control value by receiving the low temperature signal from detector 17, and by receiving the full-throttle signal at the time of a fully open output and the fuel-cut signal at the time of deceleration from terminals 18 and 19.

A fuel injection control circuit (EGI circuit), 15, determines the amount of fuel injection based on the air-fuel ratio control signal from air-fuel ratio control circuit 12, and the signals from intake airflow sensor 5 and rpm sensor 21. Although the output of the EGI circuit is applied directly to fuel injection valves 2d – 2f, it is applied to other fuel injection valves 2a ~ 2c through a variable cylinder control circuit (VCS circuit, hereafter), 16. When a light load condition is detected by this VCS circuit 16, the fuel supply to fuel injection valves 2a – 2c is shut off making cylinders f1 ~ f3 inactive. At the same time, the system is designed such that selection relay 11 is switched to the side of oxygen sensor 8, which is exclusively provided for active cylinders f4 – f6 by the same signal generated by the VCS circuit 16 to decrease the

number of cylinders.

In principle, VCS circuit 16 is designed so as not to send the fuel injection pulse signal from EGI circuit 15 to fuel injection valves 2a ~ 2c during light load conditions making cylinders f1 ~ f3 inactive so that the fuel economy can be improved during light load conditions. The basic configuration is comprised of pulse comparators, 22 and 23, for the fuel injection signal having a pulse width proportional to engine load; pulse width setting devices, 24 and 25, that output the pulse setting values (W_H) and (W_L) corresponding to the heavy and light load conditions as comparison standard values; an engine rpm comparator, 26; an rpm setting device, 27, that makes the specified low rpm setting (No) be the standard value; a flip-flop, 30, that sends the outputs from an "OR" circuit, 28, and an "AND" circuit, 29, to "set input (S)" and "reset input (R)" respectively; an "OR" circuit, 31, that inputs the output of this flip-flop 30 and the low temperature detecting device 17 of the air fuel ratio control circuit 12 mentioned above; and an "AND" circuit, 32, that receives the outputs of "OR" circuit 31 and EGI circuit as its inputs. In other words, since low temperature detecting device 17 is connected to the input side of "OR" circuit 31, the circuit is configured such that the partial cylinder deactivation command from VCS circuit 16 is cancelled when the temperature of oxygen sensors 8 and 10 is low.

Next, the operation of this invention is explained. Fig. 3 shows when engine rpm (N) and fuel injection pulse width (W) are in the 6-cylinder operation region. In this condition, as explained later, the output level of flip-flop 30 in the VCS circuit 16 becomes "1," and cylinders f1 ~ f3 are in the active condition, in other words, the system is in the full cylinder mode. After this, selection relay 11 is energized by receiving the output of "OR" circuit 31, which is "1" to perform the switching action, and the output of oxygen sensor 10, which detects the exhaust temperature of all cylinders, is input to air-fuel ratio control circuit 12. The output of comparator 13, which compares the oxygen concentration in the exhaust gas with the standard value corresponding to the stoichiometric air-fuel ratio generated by standard setting device 14, is fed back to EGI circuit 15 through clamp circuit 20 after it detects the deviation signal from the standard pulse at correction waveform generation circuit 16. Through these steps, the air-fuel ratio converges approximately to the stoichiometric value so that three-way catalyst 10 (*sic*) can function correctly. When the engine enters the light load condition, causing pulse width (W) and engine rpm (N) to shift to the 3-cylinder region indicated in Fig. 3, the output level of flip flop 30 becomes "0" and the operating condition of cylinders f1 ~ f3 becomes inactive. At this time, since low temperature detector 17 outputs the signal "0" indicating that oxygen sensor 10 is not at a temperature below the specified value, the output of "OR" circuit 31 becomes "0," closing the gate of "AND" circuit 32. At the same time, selection relay 11 is de-energized by the output "0" of "OR" circuit 31, and is switched over to the oxygen sensor 8 side as indicated in Fig. 2 so that the system is controlled in such a way that three-way catalyst 7 in the active cylinder group side consisting of cylinders f4 ~ f6 can exhibit high conversion efficiency.

When this partial cylinder operation condition continues for a long time, or during the engine warming-up period, the exhaust gas temperature entering the catalyst decreases. If the temperature becomes so low that catalyst 9 and oxygen sensor 10 can no longer function properly, low temperature detector 17 outputs

the level "1" signal to force the feedback signal to assume the "clamp" condition through clamp circuit 20. When the "clamped" signal value is applied to EGI circuit 15, the air-fuel ratio is controlled to hold at a specified fixed value. In this case, however, the control accuracy becomes slightly lower than in the case of feedback control, resulting in the situation that the function of three-way catalyst 9 tends to become degraded. In order to end this condition as quickly as possible, it is best to resume full cylinder operation. To comply with this requirement, in this invention, the output of low temperature detector 17 is input to "OR" circuit 31 to make cylinders f1 ~ f3 active whenever the low temperature detection signal (level "1" signal) is output, regardless of the output level of flip-flop 30. As a result of this forced restoration of full cylinder operation, when the exhaust temperature increases gradually to restore the function of three-way catalysts 7 and 10 *(sic)*, and as long as the engine is in the light load condition during this period, the system is switched back to the 3-cylinder operation mode, provided that the clamp signal is retracted.

Next, the operation of VCS circuit 16 is briefly described here. Since the output of EGI circuit 15 is directly applied to fuel injection valves 2d ~ 2f for cylinders f4 ~ f6, the cylinder group consisting f4 ~ f6 is always in the active state. Although other cylinders f1 ~ f3 are in the active state as long as "AND" circuit 32 gate is open, they assume the inactive state when the output level of flip-flop 30 becomes "0" and low temperature detector 17 is not generating the detection signal (output of "0"). In other words, when the detection signal is output, cylinders f1 ~ f3 retain the active state even when the output level of flip-flop is "0." Moreover, the output level of flip-flop 30 becomes "1" when pulse width (W) is greater than the standard (W_H) or when rpm (N) is lower than the standard value (No) (the 6-cylinder region in Fig. 3), and it becomes "0" when pulse width (W) becomes lower than the standard (W_L) and rpm (N) becomes higher than the standard (No) (the 3-cylinder region in Fig. 3). Since the "set" input terminal of flip-flop 30 is connected to "OR" circuit 28, and the "reset" input terminal of flip-flop 30 is connected to "AND" circuit 29, the region indicated by "maintain the same number of cylinders" in Fig. 3 is formed.

As explained above, according to this invention, it is possible to always maintain a high catalytic conversion efficiency of the three-way catalyst since the variable cylinder control is interrupted when the oxygen sensor is at the temperature condition under which it does not function properly, and full cylinder operation is maintained even under the light load condition to achieve a rapid temperature increase in the entering exhaust gas to restore the three-way catalyst function. Compared with the system in which variable cylinder control is performed by detecting engine coolant temperature, since in this invention variable cylinder control is performed by detecting the low temperature condition of the oxygen sensor that is sensitive to temperature change, it is possible to obtain accurate controls having good response characteristics. Another effect is that the system configuration is not complicated and is less expensive.

Brief Explanation of Figures

The figures show one working example of this invention. Figure 1 is a simplified configuration diagram of the overall system, Fig. 2 is a block diagram of the control system, and Fig. 3 explains the variable cylinder control pattern.

f1 ~ f6. . . Cylinders

2a – 2f . . . Fuel Injection Valves
8 and 10. . . Oxygen Sensors
12. . . Air-Fuel Ratio Control Circuit
15. . . Fuel Injection Control Circuit
16. . . Variable Cylinder Control Circuit
17. . . Low Temperature Detector

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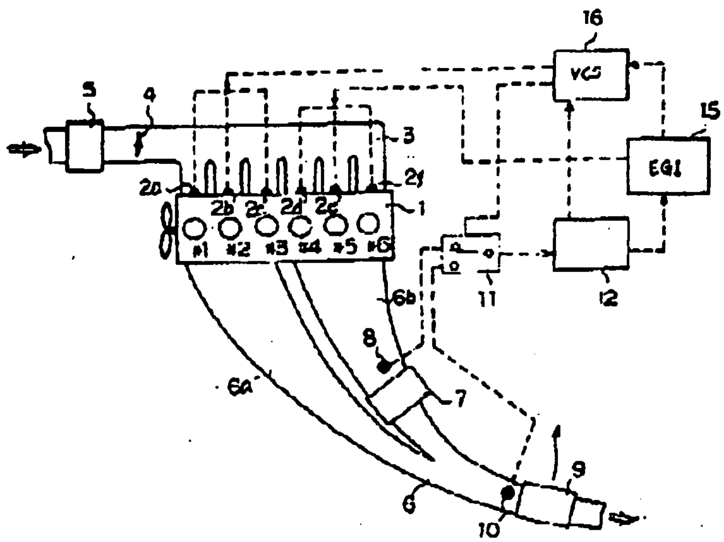
Item "Claim(s)"
7. Description of Amendment
1) "Claim(s)" on page 1 or 2 of Specification shall be amended as follows:
"Claim(s)
1. A fuel supply control type variable cylinder system for multi-cylinder engines equipped with a fuel supply system and a variable cylinder system control circuit that permit partial cylinder operation by shutting off the supply of fuel to a specified group of cylinders from the fuel supply system depending on engine load, comprising a three-way catalyst and a first oxygen sensor located in the exhaust passage of the active cylinder group; a three-way catalyst and a second oxygen sensor located in the merged passage

where the exhaust passage of inactive cylinder group meets the downstream of the exhaust passage mentioned above; a selection circuit that selects the output of the first oxygen sensor under partial cylinder operation or the output of the second oxygen sensor under full cylinder operation depending on the shut-off of the variable cylinder system circuit mentioned above; a temperature detection means that detects the temperature of the three-way catalyst in the merged passage; and an air-fuel ratio control circuit which interrupts the shutting off operation of the fuel supply signal mentioned above when the temperature detection means detects that the temperature is below a specified value, while interrupting the air-fuel ratio control that controls the fuel supply signal in a manner so as to make the air-fuel ratio become equal to the stoichiometric value.

2. The fuel supply control type variable cylinder system described in claim 1, a unique feature of which is that its temperature detection means mentioned above represents a circuit that determines the temperature by detecting that one portion of the fuel supply signal is shut off and that the output of the second oxygen sensor is higher than a specified value."

FIGURES

Fig. 1



FIGURES

Fig. 2

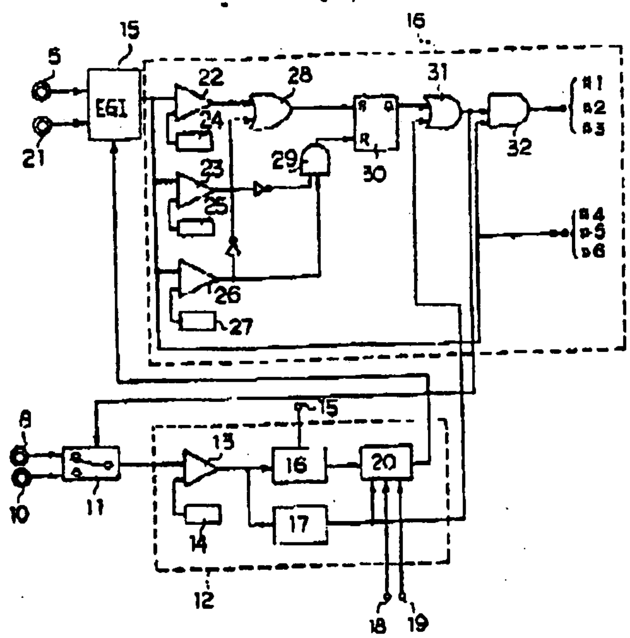
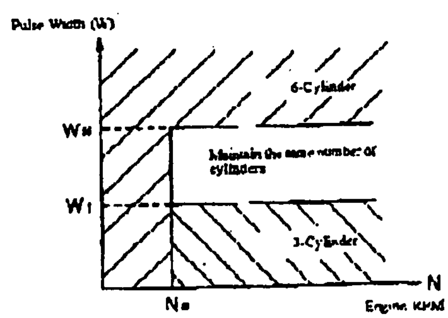


Fig. 3



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⑭燃料供給気筒数制御装置

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発明の名称

燃料供給気筒数制御装置

特許請求の範囲

1. 燃料供給量を制御する燃料供給装置と、該燃料供給装置からの所定の気筒群グループへの燃料供給信号をエンジン負荷に応じて遮断して一部気筒を休止する気筒数制御回路とを備えた多気筒エンジンに於いて、稼動気筒群グループの排気通路に設けた三元触媒と第1の酸素センサと、上記排気通路の下流の休止気筒の排気通路との合流通路に設けた三元触媒と第2の酸素センサと、上記気筒数制御回路の遮断に応じて部分気筒運転時は第1の酸素センサの出力を、全気筒運転時は第2の酸素センサの出力を選択する選択回路と、合流通路の三元触媒の温度を検出する温度検出手段と、前記温度検出手段が所定温度以下を検出した時に上記燃料供給信号の遮断を中止すると共に、空燃比が理論空燃比になるように上記燃料供給信号を制御する空燃比制御を中止する空燃比制御回路とを備えたことを特徴とする燃料供給気筒数制御装置。

2. 上記温度検出手段は、上記燃料供給信号の一部が遮断され、且つ第2の酸素センサの出力が所定値以上であることを検出して温度を判別する回路であることを特徴とする特許請求の範囲第1項記載の燃料供給気筒数制御装置。

発明の詳細な説明

本発明は排気系に三元触媒を備えて空燃比を目標値にフィードバック制御する装置を備えた燃料供給気筒数制御エンジンに関し、とくに、排気温度の低下したときには必ず全気筒運転に復帰させることにより、触媒の浄化作用を低下させないようにした装置を提供するものである。

一般にエンジンを高い負荷状態で運転すると燃費率が良好となる傾向があり、このため多気筒エンジンにおいて、エンジン負荷の小さいときに一部気筒グループに対する燃料の供給を停止し、残りの稼動気筒の単位気筒当りの負荷を相対的に高め、低負荷領域の燃費を改善するようにした気筒

数制御エンジンが考えられた。

一方、エンジンの排気対策のために、排気系に三元触媒を設置するとともに、その上流に排気センサ（酸素センサ）を設置し、このセンサ出力にもとづいて空燃比を理論空燃比となるようにフィードバック制御し、三元触媒によるHC,COの酸化とNOxの還元を共に効率よく行わせるシステムが知られている。

この空燃比制御システムを上記気筒数制御エンジンに適用すると、一部気筒グループが休止状態のときには、この休止気筒から排出された空気と、稼動気筒から排出される燃焼排気とが混合した状態で、酸素センサ、三元触媒を通過するため、酸素センサの出力は、酸素過剰な状態を検出して空燃比を極端に濃くするようなフィードバック制御が行われ、却って排気性能を低下させやすい。

このため、常時稼動する気筒の排気通路と、休止気筒および稼動気筒の合流排気通路とにそれぞれ酸素センサと三元触媒を設置し、一部気筒休止時には稼動気筒の排気のみが通る酸素センサの出力をもとにしてフィードバック制御を行い、稼動気筒の空燃比を理論空燃比となるようにして、燃焼、並びに排気の浄化性能を共に良好に維持させることも考えられる。

ところで、エンジンの減筒運転中で一部気筒運転が長時間にわたり継続するときなどは、相対的に排気温度が低下し、とくに下流側の三元触媒は休止気筒からの排出空気の流入もあつて、触媒温度は正規の活性状態に比べて大幅に温度低下するおそれがある。

このように触媒温度が低下すると、その次に全気筒運転に復帰したときは、この下流側の三元触媒は即座に良好な反応状態が得られず、このため排気性能が部分的ではあるが低下することになる。例えば、長い間緩やかな下り坂を一部気筒運転により走行した後に上り坂を登坂するような場合、上記したような現象が起りやすい。

このような問題を解決するために、排気通路の三元触媒にそれぞれ温度センサを設けておき、該温度センサにより触媒温度が所定値以下に低下したことを検知したら、気筒数制御を停止して全気筒運転に戻し、触媒温度の速やかな上昇を促がすことが考えられるが、このためには特別に温度センサが必要になり、コストアップが避けられない。

また、エンジンの低温状態を、機関冷却水温を検知することにより行い、同じく気筒数制御を停止することも考えられるが、依然として上記した全気筒運転移行時の問題は解消されず、しかも応答性が低下しやすい。

ところで、上記空燃比のフィードバック制御システムにおいて、三元触媒と同様に酸素センサも低温になると、その出力特性が酸素濃度に対する比例特性からはずれて変動する傾向があり、このため低温時にはフィードバック制御の精度が低下しやすくなる。

そこで、通常は酸素センサの出力状態から温度を判別して所定温度値以下のときは、フィードバック信号をクランプして空燃比を固定値に保持し、フィードバックによる空燃比制御を一時的に中止するようにしてある。

本発明はかかる点に鑑み、気筒数制御エンジンの排気浄化を確実にするため、部分気筒運転中稼動気筒の三元触媒の排気入口付近に設けられ、したがつて三元触媒の温度に比較的近似的な温度特性をもつ酸素センサの出力にもとづいて空燃比制御を行い下流側の酸素センサの温度が所定値以下に低下したら空燃比のフィードバック制御を中止すると同時に気筒数制御も中止して必らず全気筒運転に戻すようにすることにより、全ての気筒から排出される燃焼気体によつて三元触媒の温度を速やかに上昇させ、三元触媒の機能低下を防止し、常に良好な排気浄化作用を維持するようにした燃料供給気筒数制御エンジンを提供することを目的とする。

以下、図面にもとづいて本発明の実施例を説明する。

1は6気筒エンジン本体、#1～#3は後述するように軽負荷時に作動を休止する気筒、#4～#6は常時作動する気筒、2a～2fは各気筒の吸気ポートに取り付けられた燃料噴射弁、3は吸

気管、4はスロットルバルブ、5は吸入空気量センサ、6a，6bは排気管で気筒グループ#1～#3と#4～#6に対応して区画される。7は排気管6bに取り付けられた三元触媒、8はこの三元触媒7の入口近傍に配置された酸素センサ、9は排気管6a，6bの合流管6に取り付けられた三元触媒、10は三元触媒9の入口近傍に配置された酸素センサである。

後述する気筒数制御回路16からの信号により切換作動する選択リレー11を介して酸素センサ8，10の出力が選択的に入力される空燃比コントロール回路12は、第2図に示すようにセンサ出力を比較基準電圧と比較する比較器13、理論空燃比に相当する基準電圧を出力する基準電圧設定器14、端子15より基本パルスを受ける補正積分波形回路16、酸素センサ10の低温状態を検出する酸素温度低下検知器17、この検知器17からの低温信号や端子18，19からの全開出力時のフルスロットルスイッチ信号と減速時のフューエルカット信号を受けてフィードバック制御値をクランプ（酸素センサ8又は10の出力値に関係なく空燃比フィードバック値を既定値に固定する）するクランプ回路20とで形成される。

空燃比コントロール回路12からの空燃比制御信号と、吸入空気量センサ5，回転数センサ21とからの信号に基づいて燃料噴射量を決定する燃料噴射制御回路（EGI回路）15の出力は、燃料噴射弁2d～2fに対しては直接印加されるが、他の燃料噴射弁2a～2cへは気筒数制御回路（以下VCS回路）16を介して印加される。このVCS回路16で軽負荷状態を判別すれば、燃料噴射弁2a～2cへの燃料供給はカットされ、気筒#1～#3は休止状態になる。また同時にVCS回路16の上記気筒減少指令により、選択リレー11は稼動気筒#4～#6専用の酸素センサ8側に切り換えられるようになっている。

VCS回路16はEGI回路15からの燃料噴射パルス信号を原則として軽負荷時には燃料噴射弁2a～2cへ送らないようにして気筒#1～#3を休止状態にするもので、軽負荷時における燃焼率の改善をねらいとする。その基本的構成は原則として機関負荷に比例したパルス幅をもつ燃料噴射信号のパルス幅比較器22，23、夫々低負荷と高負荷に対応したパルス幅設定値（Ws），（WL）を比較基準値として出力するパルス幅設定器24，25、エンジン回転数比較器26、一定の低回転数設定値（NO）を基準値にする回転数設定器27、そしてOR回路28とAND回路29の出力を夫々セット入力（S）とリセット入力（R）とするフリップフロップ30、このフリップフロップ30と上記空燃比コントロール回路12の低温検知器17との出力を入力とするOR回路31、OR回路31とEGI回路の出力を入力とするAND回路32とからなる。つまり、OR回路31の入力側に低温検知器17を設けるため、酸素センサ8，10が低温のときには、VCS回路16の一部気筒休止指令を打消す回路構成にしてある。

次に本発明の作用を説明する。まずエンジン回転数（N）と燃料噴射パルス幅（W）が第3図で示された6気筒領域にあるときは、後述するようにVCS回路16のフリップフロップ30の出力レベルは"1"となり、気筒#1～#3を稼動状態にする、即ち全気筒運転を行う。これに伴いOR回路31の出力"1"を受けて選択リレー11が励磁されて切換作動し、全気筒の排気濃度を検出する酸素センサ10の出力が空燃比コントロール回路12に入力する。排気中の酸素濃度を理論空燃比に対応する基準設定器14の基準値と比較する比較器13の出力は、積分波形形成回路16において基本パルスとの偏差信号を検出したうえで、クランプ回路20を通過してEGI回路15へフィードバックされる。これによって三元触媒10が適正に機能するように空燃比が理論空燃比に収束させられるのである。ここで機関が軽負荷状態になり、パルス幅（W）とエンジン回転数（N）が第3図の3気筒領域に移行すると、フリップフロップ30の出力レベルは"0"となり気筒#1～#3を休止状態にする。なおこのとき低温検知器17は酸素センサ10が所定値以下の低温状態でないという信号、即ちレベル"0"を出力しているために

OR回路31の出力は"0"となり、AND回路32のゲートを閉じる。同時にOR回路31の出力"0"により選択リレー11は励磁が解かれて、第2図に示す如く、酸素センサ8側に切り換え、排気側グループ#4～#6側の三元触媒7が高い転換効率を発揮しうるようにコントロールする。

ところで、この一部気筒休止状態が長く続いたり、あるいは低負荷運転時は触媒流入排気温度は低下する。いま触媒9や酸素センサ10が温度低下で出力を発揮しえない程度に低温になると、低温検知器17がレベル"1"を出力してクランプ回路20を介してフィードバック信号をクランプ状態にする。クランプされた信号値がEGI回路15に印加されると、空燃比は所定の固定値に保持されるように制御されるが、この場合には、フィードバック制御に比べて精度が若干低下するため、三元触媒9の機能は低下しがちになる。このような状態からできるだけ早く抜け出すためには全気筒運転に戻すことが好ましく、そこで本発明は低温検知器17の出力をOR回路31に入力し、フリップフロップ30の出力レベルに関係なく、低温時の検出信号（レベル"1"）を出力したときは、気筒#1～#3を駆動状態にする。このようにして全気筒運転に強制的に復帰させた結果、排気温度が次第に上昇して三元触媒7，10の機能が回復すると、クランプ信号の解除を条件として、このとき軽負荷状態ならば再び3気筒運転に切り換わるのである。

ここでVCS回路16の作用を簡単に説明すると、EGI回路15の出力が気筒#4～#6の燃料噴射弁2d～2fに対しては直接的に印加されるために、この気筒グループ#4～#6は常時駆動状態にある。他の気筒#1～#3はAND回路32のゲートが開いているあいだは駆動状態になるが、フリップフロップ30の出力レベルが"0"で、かつ低温検知器17が検知信号を発していないとき（出力は"0"）に休止状態になる。換言すると、検知信号が出力されているときは、フリップフロップ30の出力レベルが"0"でも気筒#1～#3は駆動状態を維持する。なおフリップフロップ30の出力レベルはパルス信号幅(W)が基準値（WH）以上か又は回転数(N)が基準値（No）以下の場合（第3図の6気筒領域）には"1"になり、パルス幅(W)が基準値（WL）以下で、かつ回転数(N)が基準値（No）以上の場合（第3図の3気筒領域）には"0"になる。フリップフロップ30のセット入力端子をOR回路28に、リセット入力端子をAND回路29に夫々接続したため、第3図の気筒数維持の領域が形成される。

以上のように本発明によれば、酸素センサが適正に作動しない低温状態のときには気筒数制御を停止し、たとえ軽負荷時でも全気筒を駆動状態に保ち、速やかな触媒流入排気温度の上昇を図って三元触媒の機能を回復させるので、常に高い転換効率を維持することができる。また気筒数制御を機関冷却水温を検知して行なうのに比べ、温度変化に敏感な酸素センサの低温状態を検知して行なうため、その応答性が良好で適確な制御が得られると共に、構成が複雑化せず安価になる効果を有する。

図面の簡単な説明

図面は本発明の実施の一例を示すもので、第1図は概略構成図、第2図は制御系のブロック図、第3図は気筒数制御パターンの説明図である。

#1～#6…気筒、2a～2f…燃料噴射弁、8，10…酸素センサ、12…空燃比コントロール回路、15…燃料噴射制御回路、16…気筒数制御回路、17…低温検知器。

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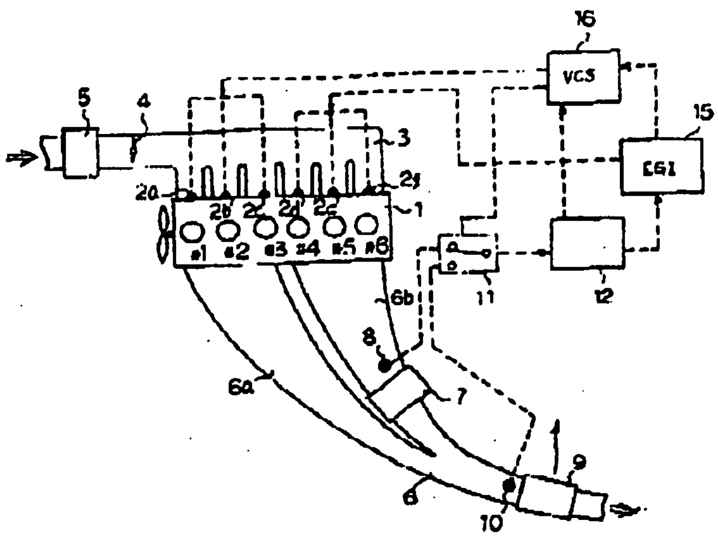
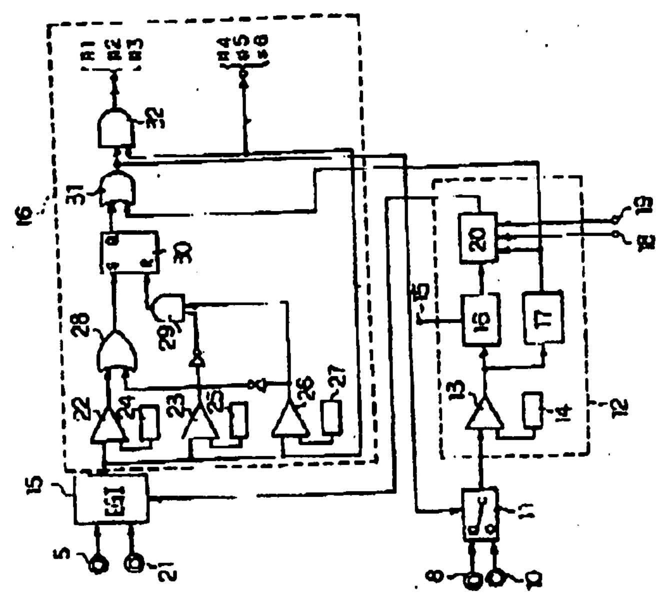
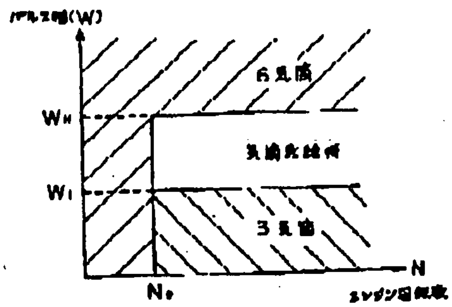
第 1 図


16
VCS
15
EGI
5
4
3
2a
2b
2c
2d
2e
2f
1
#1
#2
#3
#4
#5
#6
11
12
6b
8
7
6a
9
6
10

第 2 図


EGI
15
5
21
16
22
23
24
25
26
27
28
29
30
31
32
#1
#2
#3
#4
#5
#6
12
13
14
16
17
20
19
18
11
8
10

第3図



手続補正書

昭和54年9月25日

特許庁長官 川原能雄 殿

1. 事件の表示
昭和53年特許願第86996号

2. 発明の名称
燃料供給気筒数制御装置

3. 補正をする者
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5. 補正命令の日付 自発

6. 補正の対象
明細書中「特許請求の範囲」の欄

特許庁 54.9.26

7. 補正の内容
1) 明細書第1頁乃至第2頁の「特許請求の範囲」を次のように補正する。

「特許請求の範囲
1. 燃料供給量を制御する燃料供給装置と、前記燃料供給装置からの所定の気筒群グループへの燃料供給信号をエンジン負荷に応じて遮断して部分気筒運転する気筒数制御回路とを備えた多気筒エンジンに於いて、稼働気筒群グループの排気通路に設けた三元触媒と第1の酸素センサと、上記排気通路の下流の休止気筒の排気通路との合流通路に設けた三元触媒と第2の酸素センサと、上記気筒数制御回路の遮断に応じて部分気筒運転時は第1の酸素センサの出力を、全気筒運転時は第2の酸素センサの出力を選択する選択回路と、合流通路の三元触媒の温度を検出する温度検出手段と、前記温度検出手段が所定温度以下を検出した時に上記燃料供給信号の遮断を中止すると共に、空燃比が理論空燃比になるように上記燃料供給信号を制御する空燃比制御を中止する空燃比制御回路とを備えたことを特徴とする燃料供給気筒数制御装置。

2. 上記温度検出手段は、上記燃料供給信号の一部が遮断され、且つ第2の酸素センサの出力が所定値以上であることを検出して温度を判別する回路であることを特徴とする特許請求の範囲第1項記載の燃料供給気筒数制御装置。」